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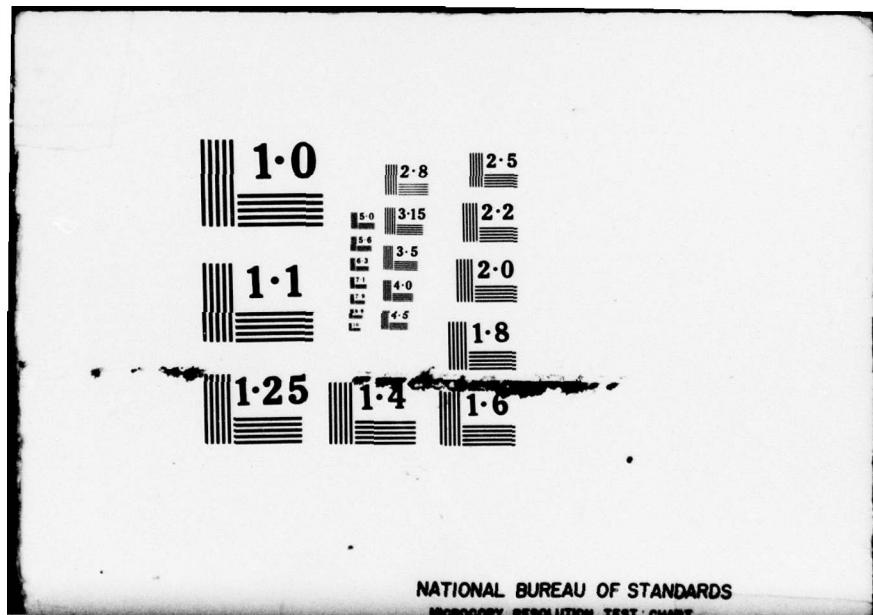
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MAR 78

DCIEM Technical Report No. 78X6

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AN EVALUATION OF FITNESS TRAINING

FOR RECRUITS IN THE CANADIAN FORCES.

BY

W.S./MYLES, S./BIGGS AND H./MacDONALD

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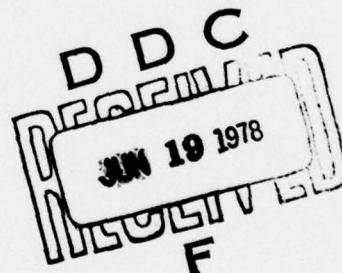
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ABSTRACT

Aerobic power, skinfold thickness and lung function were measured for male and female recruits before and after training at CFRS Cornwallis and ERFC St. Jean. The data indicated that the programmes at both establishments produced an improvement in these fitness parameters which was impressive considering that the fitness training portion of the course lasts only nine weeks. Fitness levels among recruits graduating from Cornwallis and St. Jean compared favourably with those measured for officer cadets graduating from the Canadian Forces Officer Candidate School and with levels observed among other segments of the Canadian military population of comparable age. This report also discusses the problem of motivating the recruit to maintain a high fitness level during the remainder of his or her military career.

INTRODUCTION

An evaluation of the fitness of young men and women before
and after the recruit training programme was conducted at CFRS
Cornwallis and ERFC St. Jean. The initial assessment at Cornwallis
was carried out in May 1977, and graduates of the course were
retested in July. Pre- and post-training measurements were made
at St. Jean in July and September. This report outlines and dis-
cusses changes in aerobic fitness, body composition and lung function.

METHODS

Subjects and Training Programme

Ages of the recruits varied between 17 and 25 with the majority
being less than 20 years of age. Data is presented only for those
who completed the course.

Recruit training at Cornwallis and St. Jean lasts 13 weeks.
Since the first week of the course is devoted largely to orientation,
and training in the final two weeks is curtailed due to preparations
for graduation, most of the fitness training occurs in about nine
weeks. The recruits are exposed to a wide variety of training methods
designed to develop aerobic power, muscular strength, aerobic and
muscular endurance as well as various sports skills such as swimming.
Male and female recruits receive equivalent training intended to
enable them to meet equivalent standards.

Pulmonary Function

Forced vital capacity, forced expiratory volume in one minute
and peak flow were recorded using a Monaghan M403 pulmonary function
analyser. Test values were compared with norms for the individual's
age, sex and height.

Body Composition

Height and weight were recorded and three skinfold measure-
ments were taken using Harpenden calipers. The sum of the skinfold
thicknesses (triceps, subscapular and suprailiac) was used to est-
imate total body fat. For male subjects, a skinfold sum less than
35 mm is classified as "lean", 35-50 mm as "acceptable", and greater
than 50 mm as "too much body fat". Corresponding standards for
females of less than 41 mm, 41-55 mm, and greater than 55 mm, are
tentative and may be adjusted as more data on females in the mil-
itary is acquired.

Aerobic Fitness

Aerobic fitness is an important aspect of physical fitness for young recruits. It can be expressed in terms of maximum oxygen uptake (VO_2 max) which is a measure of the amount of oxygen the body can deliver to the working muscles. Using the nomogram developed by Astrand and Rhyming (2), VO_2 max was predicted from the heart rate response to exercise on a MONARK bicycle ergometer. The bicycle test was eight minutes in total and consisted of two four-minute workloads. The initial four-minutes at a workload of 300-600 kg-m/min allowed the subjects to warm up. The second workload (750-1200 kg-m/min) was designed to produce a heart rate that was 70-85% of the individual's maximum predicted for his age. Individual values of VO_2 max were categorized as "POOR", "FAIR", "GOOD", or "EXCELLENT" based on the standards of Cooper (5).

RESULTS

CFRS Cornwallis

Table 1 shows pre- and post-training means for VO_2 max, running time for the 1.5 mile distance, skinfold thickness and body weight for those recruits completing courses 7720 and 7720(W). The male recruits showed an improvement in VO_2 max and running time and a decrease in skinfold thickness and body weight. Female recruits showed an increase in VO_2 max, an improvement in running time, but no significant change in skinfold thickness or body weight.

Individual values for VO_2 max can be categorized as "POOR", "FAIR", "GOOD" or "EXCELLENT" and the lower two categories can be further labelled as "unfit". Table 2 shows the percent of male and female recruits in each category before and after training at Cornwallis. Training decreased the percentage of male recruits considered unfit from 34% to 5% and the percentage of unfit female recruits from 41% to 4%.

Skinfold thickness measurements can also be categorized as LEAN, ACCEPTABLE and TOO MUCH BODY FAT. Table 3 shows the percentage of male and female recruits in each category before and after training at Cornwallis. The percentage of male and female recruits with too much body fat decreased from 20% to 4%, and from 43% to 35%, respectively.

ERFC St. Jean

Table 4 shows pre- and post-training means for VO_2 max, running time for 1.5 mile distance, skinfold thickness and body weight for

those recruits completing courses 7729 and 7729(W). Male recruits showed an increase in VO_2 max and body weight, a decrease in running time, but no significant change in skinfold thickness. Female recruits showed an improvement in running time and an increase in body weight, but no significant change in the other fitness parameters.

Table 5 shows the distribution of male and female recruits into fitness categories before and after training at St. Jean. Whereas the percentage of male recruits considered unfit decreased with training from 37% to 7%, the percentage of unfit female recruits rose slightly from 6% to 13%.

Table 6 shows the distribution of male and female recruits into categories of skinfold thickness before and after training at St. Jean. The percentage of male and female recruits with too much body fat decreased from 7% to 2% and from 12% to 9%, respectively.

A Comparison Between Cornwallis and St. Jean

The data in Tables 1-6 permit a comparison between recruits at Cornwallis and those at St. Jean. Table 7 shows the statistical significance of differences between the fitness parameters in Tables 1 and 4. There was no significant difference in VO_2 max between male recruits at Cornwallis and those at St. Jean either before or after training. Running time was higher and skinfold thickness was lower on both occasions at St. Jean. Although the body weight was lower at St. Jean before training, it was not significantly different at the end of training. There was a difference in height with male recruits at Cornwallis being slightly taller than their counterparts at St. Jean.

Female recruits at St. Jean had a higher VO_2 max, a lower skinfold thickness and body weight before training than their counterparts at Cornwallis. There was no significant difference in height or in running time before training. After training the difference in VO_2 max was no longer significant but running times were higher at St. Jean.

Tables 2 and 5 show that similar percentages of male recruits at Cornwallis and St. Jean were categorized as unfit before and after training. On the other hand, the percentage of female recruits at St. Jean categorized as unfit before training was markedly lower than that at Cornwallis. After training the difference between female recruits at the two training establishments was much less obvious.

Tables 3 and 6 show that the percentage of male and female recruits categorized as having too much body fat before training

was very much higher at Cornwallis. After training, the difference disappeared among male recruits but persisted among female recruits.

Pulmonary Function

The lung functions monitored were within normal limits for all recruits. Smoking habits were documented at Cornwallis and showed that 69% of male recruits and 57% of female recruits were smokers at the end of the course. There was also evidence to suggest that an increase in the number of smokers and in cigarette consumptiom per smoker occurred during the course. Unfortunately the collection of similar data at St. Jean was incomplete.

DISCUSSION

The effectiveness of any training programme depends, in part, on the condition of the recruits entering the course. The pre-training VO_2 max of male recruits at Cornwallis and St. Jean and female recruits at Cornwallis (Tables 1 and 4) were comparable to those observed among the civilian population (4). By contrast pre-training VO_2 max for female recruits at St. Jean (Table 4) was markedly higher than reported for Canadian civilian females (4). As a rule, the largest improvement will occur in those recruits who have the lowest initial fitness level. The same argument applies to the effect of training on body composition, and a decrease in body fat is likely to occur only in those with an excess of body fat. Mean values for skinfold thickness for recruits at both establishments (Tables 1 and 4) were within acceptable limits.

The training programmes for female recruits at Cornwallis and for male recruits at both establishments were equally effective in improving VO_2 max. The improvement was particularily impressive considering the relatively short duration of the course. High pre-training levels of VO_2 max for female recruits at St. Jean probably explain why they showed no significant increase with training. On the other hand, the majority of male and female recruits at both establishments completed the course with fitness levels in the GOOD or EXCELLENT category (Tables 2 and 5). Since most of the male and female recruits at St. Jean and the female recruits at Cornwallis began training with skinfold thickness measurements which were relatively low, it is not surprising that training had no consistent effect on mean values (Tables 1 and 4). On the other hand, female recruits at Cornwallis might have been expected to finish the course with a smaller skinfold thickness. This opinion is expressed with a full awareness that the "ideal"

body fat content for young women is poorly defined. A definitive study of the question requires a knowledge of caloric intake during training. It is worth noting that, except for the female recruits at Cornwallis, very few of the others completed the course with too much body fat (Tables 3 and 6).

A comparison can be made between male recruits at Cornwallis and St. Jean, officer candidates at BOTC Chilliwack (1), and CF personnel of comparable age (7). Table 8 shows that the average pre- and post-training VO_2 max for male recruits was very nearly the same as those for officer candidates. The post-training levels were also higher than the mean value found for 621 CF personnel aged 18-24 years and tested at bases throughout Canada. Table 8 also shows running times for the 1.5 mile distance. When time and distance were converted to an equivalent VO_2 max using the equation of Margaria et al (6), the percentage improvements for recruits were slightly better than that achieved by officer candidates. These data indicate that the training programmes for recruits at Cornwallis and St. Jean were as effective as that administered to officer candidates at Chilliwack.

Although insufficient data are available at the present time to permit a comparison between female recruits and other CF women, similar to that shown in Table 8, conclusions regarding the effectiveness of the training programme for women are possible. For example, women tend to have a lower VO_2 max expressed as ml/kg x min than men of the same age. This is probably due to the fact that women in general have a higher body fat content and a lower haemoglobin level than men. Astrand and Rodahl (3) reported a 15-20% lower VO_2 max in women as compared to men at the same level of training. Since the post-training VO_2 max for female recruits at Cornwallis and St. Jean were 82% and 84%, respectively, of the values for their male counterparts, this indicates that they achieved the same level of training and that their programmes were just as effective.

An opportunity arose to retest 26 of the female recruits from Cornwallis about three months after their graduation. The mean VO_2 max for thses 26 women was 9% lower than their post-training value, but still 15% above their pre-training level (Table 1). These results, collected only three months after the recruits completed training, are not sufficient to confirm or deny the suggestion that the fitness level of recruits returns to pre-training levels soon after they leave the training establishments. On the other hand, levels of VO_2 max measured among the male CF population who have completed recruit training (7) would appear to support this contention. Perhaps more emphasis during recruit

training should be placed on a rationale for personal fitness; one that will motivate through a better understanding of the benefits of fitness to the individual. A rationale which appeals to self-interest is likely to be more effective than one which stresses duty to the organization.

The programmes at Cornwallis and St. Jean involved many different types of training such as running, swimming, and circuit training. Although this obviously exposed recruits to a variety of training methods, it made it difficult to assess the total training stimulus at each establishement. Hence it is not possible to compare training programmes at Cornwallis and St. Jean (intensity, frequency, and duration of exercise etc) other than to say that they were different. For example, the daily programme at St. Jean was supplemented by an extra running programme which emphasized distance (duration). Male recruits were expected to run 5 miles in 45 minutes and female recruits 3 miles in 30 minutes by the end of 7 weeks. In spite of such differences, the end product was essentially the same.

CONCLUSIONS

1. The aerobic fitness levels of recruits graduating from Cornwallis and St. Jean are remarkably similar and the training programmes at both establishments appear to be equally effective.

2. The aerobic fitness level of male recruits compares favourably with that of officer candidates graduating from BOTC, Chilliwack, and with that observed among the rest of the CF population of comparable age.

3. The aerobic fitness level of female recruits graduating from Cornwallis and St. Jean is equivalent to that of their male counterparts and their training programmes appear to be just as effective.

4. Measurements of body composition and lung function indicate that adequate standards are achieved in these aspects of fitness.

RECOMMENDATIONS

Since this study indicates that Cornwallis and St. Jean both have an effective training programme, future efforts should be directed towards ensuring that the recruit maintains his fitness level during the remainder of his military career. To this end it is recommended that:

1. A study be carried out to determine if and why fitness declines after recruit training.

2. More emphasis be placed on a personal rationale for fitness during recruit training.

3. Data be collected to determine whether the smoking and eating habits of recruits change during training and whether a healthier lifestyle can be promoted at this early phase in their military careers.

4. The first three recommendations can be achieved by using the resources of the CF Life Quality Improvement Program (LQUIP), currently in the planning and trial phase.

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Table 1: Effect of training on fitness parameters at Cornwallis

	$\dot{V}O_2$ max (ml/kg min)	Time for 1.5 mile (min)	Skinfold Thickness (mm)	Body Weight (kg)	Height (cm)
Males					
Pre-training	46.1 ± 0.9	11.4 ± 0.2	37.0 ± 1.6	71.3 ± 1.0	174.8 ± 0.7
Post-training	54.4 ± 0.9	10.4 ± 0.1	32.9 ± 1.0	70.0 ± 0.8	
Number of Recruits	85	84	85	85	85
% of change	+18		−11	−2	
Significance	$p < 0.001$	$p\ 0 \leqslant 001$	$p < 0.001$	$p < 0.001$	
Females					
Pre-training	36.9 ± 0.9	14.5 ± 0.2	52.7 ± 2.0	59.8 ± 1.2	161.7 ± 1.0
Post-training	44.4 ± 1.0	12.6 ± 0.1	50.3 ± 1.8	60.3 ± 0.9	
Number of Recruits	51	51	51	51	51
% of change	+20		−5	+1	
Significance	$p < 0.001$	$p < 0.001$	N.S.	N.S.	

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Table 2: Distribution of recruits at Cornwallis into fitness categories.

	Poor + Fair = Unfit	Good + Excel = Fit
Males		
Pre-training	7 + 27 = 34	42 + 24 = 66
Post-training	0 + 5 = 5	34 + 61 = 95
Females		
Pre-training	4 + 37 = 41	41 + 18 = 59
Post-training	0 + 4 = 4	35 + 61 = 96

Values are percentages of the total number of
male or female recruits completing the course.

Table 3: Distribution of recruits at Cornwallis into skinfold thickness categories.

	Skinfold thickness categories		
	Lean	Acceptable	Too much body fat
Males			
Pre-training	56	24	20
Post-training	63	33	4
Females			
Pre-training	24	33	43
Post-training	28	37	35

Values are percentages of the total number of male or female recruits completing the course.

Table 4: Effect of training on fitness parameters at St. Jean.

	$\dot{V}O_2$ max (ml/kg×min)	Time for 1.5 mile (min)	Skinfold Thickness (mm)	Body Weight (kg)	Height (cm)
Males					
Pre-training	46.5 ± 1.4	12.5 ± 0.1	30.4 ± 1.6	66.6 ± 1.2	171.9 ± 0.9
Post-training	52.4 ± 1.0	11.8 ± 0.1	29.2 ± 1.2	67.9 ± 1.1	
Number of Recruits	46	44	46	46	46
% of Change	+13		−4	+2	
Significance	p<0.001	p<0.001	N.S.	p<0.01	
Females					
Pre-training	43.1 ± 0.9	14.9 ± 0.1	43.3 ± 2.2	54.4 ± 1.4	159.3 ± 1.0
Post-training	44.2 ± 1.4	13.9 ± 0.2	42.9 ± 1.9	56.3 ± 1.4	
Number of Recruits	32	31	32	32	32
% of Change	+3		−1	+3	
Significance	N.S.	p<0.001	N.S.	p<0.001	

Values are mean ± S.E.

Table 5: Distribution of recruits at St. Jean into fitness Categories.

	Fitness Categories	
	Poor + Fair = Unfit	Good + Excel = Fit
Males		
Pre-training	7 + 30 = 37	29 + 24 = 63
Post-training	0 + 7 = 7	45 + 48 = 93
Females		
Pre-training	0 + 6 = 6	39 + 55 = 94
Post-training	0 + 13 = 13	26 + 61 = 87

Values are percentages of total number of male
and female recruits completing the course.

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Table 6: **Distribution of recruits at St. Jean into skinfold thickness categories.**

	Skinfold thickness categories		
	Lean	Acceptable	Too much body fat
Males			
Pre-training	71	22	7
Post-training	87	11	2
Females			
Pre-training	41	47	12
Post-training	53	38	9

Values are percentages of total number of male or female recruits completing the course.

Table 7: **Statistical significance of differences between fitness parameters measured at Cornwallis and St. Jean.**

	VO$_2$ max (ml/kgxmin)	Time for 1.5 mile (min)	Skinfold Thickness (mm)	Body Weight (kg)	Height (cm)
Males					
Pre-training	N.S.	SJ>CW	CW>SJ	CW>SJ	CW>SJ
Post-training	N.S.	SJ>CW	CW>SJ	N.S.	
Females					
Pre-training	p>0.001	N.S.	CW>SJ	CW>SJ	N.S.
Post-training	SJ>CW	SJ>CW	CW>SJ	CW>SJ	

Statistical analysis was by a students t-test and differences at less than 5% level were considered significant. The abreviations N.S. indicate no significant difference and the abreviation CW>SJ indicates that the mean for recruits at Cornwallis was higher than the mean for recruits at St. Jean, and vice versa.

Table 8: **A comparison between male recruits, officer**
candidates and Canadian military personnel
of comparable size.

	VO_2 max (ml/kgxmin)		Time for 1.5 mile (min)	
	before	after	before	after
Cornwallis recruits	46.1	54.4	11.4	10.4
St. Jean recruits	46.5	52.4	12.5	11.8
BOTC, Chilliwack	48.7	53.2	10.1	9.6
Canadian military 18-24 years n = 621	46.4		--	

Values are means.